EFFECT OF STRETCHING AND DYNAMIC SURYANAMASKAR ON BOWLING PERFORMANCE IN CRICKET

A Synopsis for **Doctor of Philosophy in Physical Education**

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INTRODUCTION

Cricket fast bowling has received considerable research attention in recent years; several issues remain to be addressed. Cricket players often begin their exercise with a warm-up protocol, which typically consists of jogging one or two laps around the gym followed by a series of dynamic stretches. It is widely believed that pre-exercise dynamic stretching reduces the risk of injury and enhances performance. However, recent studies reported that pre-exercise dynamic stretching increases maximal force production, jump height and speed therefore the inclusion of dynamic stretching as part of a pre exercise warm-up routine has been commonplace in a multitude of sports, including cricket. Further there are a number of reports on the effect of yoga training on physiological and motor functions; scientific literature is deficient on the physiological effects of suryanamaskar that is an integral part of modern yoga training. Suryanamaskar consists of a sequence of 12 yoga postures, each posture counteracting the preceding one producing a balance between flexion and extension, performed with synchronized breathing and aerobic activity (Pratima M.Bhutkar, 2008; Gauri Shankar, 2011). Suryanamaskar stimulates every large muscle group in the body. It stretches up to 97% of the body muscles and improves the general physical fitness by strengthening the muscles (Gauri Shankar, 2011, Rajani Dalvi, 2012). Chaturanga Dandasana, yoga plank or push up, which is one of the 12 postures of suryanamaskar, is excellent for core control (Cheryl Fenner Brown, 2011).

Some research studies advocate a rapid method of suryanamaskar performing multiple rounds in a fast manner similar to physical exercise. It has been suggested that suryanamaskar at different speeds provides different benefits and that when it is done rapidly it warms up the body and acts as a cardio tonic, whereas when done slowly it strengthens and tones the musculature and enhances functioning of internal organs(Sun Salutation, 2010).

Furthermore, insufficient research exists on the effects of fast suryanamaskar on physical performance parameters which may closely related to the actual demands of the game.

In cricket, pace bowling is a part requiring high-intensity, intermittent, non-continuous exercise that includes many sprints of different durations, rapid acceleration, jumping, agility, and so on. However, to date, no research has investigated the effects of dynamic stretching protocol and fast suryanamaskar modes on physical and bowling performance in cricket bowlers.

Thus, we aimed to test that whether rapid suryanamaskar mode is beneficial to neuromuscular and bowling performance or dynamic stretching is beneficial for the same. Therefore, the specific purpose of this study is to examine the acute effects of dynamic stretching and rapid suryanamaskar within a warm-up protocol on neuromuscular and bowling performance of cricket bowlers.

Statement of the problem

The purpose of the study is to compare the acute effects of fast Surya Namaskar and dynamic stretching protocol on neuromuscular function and Bowling performance in cricket.

Objectives of the Study

The objectives of this study will be:

1. To determine the acute effect of Surya Namaskar on neuromuscular function
2. To determine the dynamic stretching protocol effect on neuromuscular function
3. To determine the effect of fast Surya Namaskar and dynamic stretching protocol on bowling performance.
4. To compare the acute effects of fast Surya Namaskar and dynamic stretching protocol on neuromuscular function and Bowling performance.

Delimitation

The study will be delimited to the following factors:

1. Thirty (30) male pace bowlers will be chosen as subjects
2. The age of subjects will be of 18-25 years
3. The subjects will be categorized into two groups namely dynamic stretching and fast suryanamaskar group
4. Subject will be chosen for collection of data from WB.

Limitations

1. The factors like diet, lifestyle, daily routine, habits etc. of human subjects that could not be controlled and might have effect on the result of the study was considered as limitation of the study
2. Specific motivational technique was not applied on the subjects who will be considered as the limitation of the study.
3. The previous experience of the subjects regarding the test was considered as limitation of the study.

Hypothesis

H1 Fast suryanamaskar will have an acute significant effect on neuromuscular function of cricket players

H2 Dynamic Stretching will have an immediate significant effect on neuromuscular function of cricket players

H3 There will be a significant difference in neuromuscular function of cricket players between two categories of group (Fast Surya Namaskar and Dynamic Stretching)

Definition and explanation of related terms

Dynamic stretching is a form of stretching beneficial in sports utilizing momentum from form, and the momentum from static-active stretching strength, in an effort to propel the muscle into an extended range of motion not exceeding one's static-passive stretching ability. Anything beyond this range of motion becomes ballistic stretching. This form of stretching prepares the body for physical exertion and sports performance. In the past it was the practice to undertake static stretching before exercise. Dynamic stretching increases range of movement, blood and oxygen flow to soft tissues prior to exertion. Increasingly coaches and sports trainers are aware of the role in dynamic stretching in improving performance and reducing the risk of injury.

Warming-up is performed before a performance or practice. Athletes, singers, actors and others warm up before stressing their muscles.

Surya Namaskar The Surya Namaskar is performed usually early in the morning facing the morning rising Sun. The Namskar is done in 12 steps, each step having its own posture (including position and form) with its own breathing pattern (inhalation or exhalation), and its own mantra. This sequence of movements and asanas can be practised on varying levels of awareness, ranging from that of physical exercise in various styles,

Neuromuscular function is a chemical synapse formed by the contact between the presynaptic terminal of a motor neuron and the postsynaptic membrane of a muscle fiber. It is at the neuromuscular junction that a motor neuron is able to transmit a signal to the muscle fiber causing in to contract.

Significance of the Study

1. The study may disclose new facts regarding dynamic stretching warm up and fast surya namskar on neuromuscular function during warm-up in cricket.
2. The result of the study may bring consciousness among cricket players regarding the neuromuscular function level after warm-up.
3. The study will highlight the level of neuromuscular condition of pace bowlers.
4. The result of the study will help to motivate the pace bowlers to undertake suryanamaskar as a part of warm-up before individual specific warm-up schedule.
5. The study would provide guidance to the player, coach, teacher etc. and aspirants to use dynamic suryanamaskar as an alternative warming up protocol.

CHAPTER- II

REVIEW OF RELATED LITERATURE

Sinha B. et al. (2004), done a research on "Energy Cost and Cardiorespiratory Changes during the Practice of Surya Namaskar". The study contains the following. Surya Namaskar (SN), a group of Yogic exercise consists of a set of twelve postures which is practiced by some of the yoga practitioners. The present study was undertaken to observe critically the energy cost and different cardiorespiratory changes during the practice of SN. Twenty-one male volunteers from the Indian Army practiced selected Yogic exercises for six days in a week for three months duration. The Yogic practice schedule consisted of Hatha Yogic Asanas (28 min), Pranayama (10.5 min) and Meditation (5 min). In the Yogic practice schedule 1st they practiced Kapala Bhati (breathing maneuvers) for 2 min then Yoga mudra (yogic postural exercise) for 2 min, after that they took rest until oxygen consumption and heart rate (HR) came to resting value. Subsequently subjects performed SN for 3 min 40 seconds on an average. After three months of training at the beginning of the fourth month subjects performed entire Yogic practice schedule in the laboratory as they practiced during their training session and experiments were carried out. Their pulmonary ventilation, carbon dioxide output, Oxygen consumption, HR and other cardiorespiratory parameters were measured during the actual practice of SN. Oxygen consumption was highest in the eighth posture (1.22+/- 0.073 1 min (-1)) and lowest in the first posture (0.35+/-0.02 1 min (-1)). Total energy cost throughout the practice of SN was 13.91 kcal and at an average of 3.79 kcal/min. During its practice highest HR was 101+/-13.5 bpm. As an aerobic exercise SN seemed to be ideal as it involves both static stretching and slow dynamic component of exercise with optimal stress on the cardiorespiratory system.

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Pratima M. et al. (2008), done a research on "Effect of Suryanamaskar Practice on Cardio-respiratory Fitness Parameters: A Pilot Study". The study contains the following. In recent times, medical fraternity is attracted towards yoga. Suryanamaskar is a part of yogic practices and is believed to be an all-round exercise. The present study tested efficacy of regular practice of 'suryanamaskar' in improving the cardio-respiratory fitness. The present study was conducted on 78 subjects, (48 males and 30 females). It was observed that 6 months of suryanamaskar practice decreases resting pulse rate and blood pressure. At the same time it increases cardio-respiratory efficiency and respiratory capacity as evaluated by bicycle ergometer and various lung functions tests, in both male and female subjects. From this study we

conclude that suryanamaskar practice can be advocated to improve cardio-respiratory efficiency for patients as well as healthy individuals.

Bhutkar et al. (2008) conducted on 78 subjects, (48 males and 30 females). It was observed that 6 months of suryanamaskar practice decreases resting pulse rate and blood pressure. At the same time it increases cardio-respiratory efficiency and respiratory capacity as evaluated by bicycle ergometry and various lung functions tests, in both male and female subjects. From this study we conclude that suryanamaskar practice can be advocated to improve cardio-respiratory efficiency for patients as well as healthy individuals.

Krzysztof Stec[1], Rajeev Choudhary[1], Leslaw Kulmatycki[2] The objective of the study was to determine the effects of dynamic Surya Namaskar (sun salutations) on the differential chest circumference of selected physical education students Banaras Hindu University. Varanasi Basic procedures. The subjects were selected and used as one practicing group. Dynamic Surya Namaskar was considered the independent variable and differential chest circumference was condidered the dependent variable . The test was for differential chest circumference. The repeated Measures Design was used for this study. Only one group of 20 participants was created. Tests were administered at regular intervals of two weeks. The tests started four weeks prior to the dynamic Surya Namaskar (DNS) treatment and took place every two weeks, three times. Thereafter, tests took place every two weeks during tehe treatmentand ager the completion of the treatment, they were continued for the following four-week period. Main findings. To determine the effect of dynamic Surya Namaskar on physiological and anthropometric variables of selected physical education students at Banaras Hindu significant ($p < 0.05$) effect of dynamic Surya Namaskar was found.

BISWAJIT SINHA*, TULIKA DASGUPTA SINHA, ANJANA PATHAK AND O.S. TOMER: Surya Namaskar (SN), a popular traditional Indian yogic practice called “Sun

Salutations", includes practice of twelve physical postures involving alternate backward bending and forward bending postures. The practice of twelve postures in succession makes one round of its practice. Many people practise it as part of their daily physical fitness regimen. No study is available to compare cardiorespiratory responses of SN with bicycle exercise (BE). 20 healthy Yoga instructors practicing various Yogic practices including SN since last 7-8 years participated in the study. They performed SN in the laboratory according to their customary daily practice routine. The subject also performed incremental load bicycle exercise test till exhaustion on their second visit for measuring their □ V O2 max. SN and BE were compared at three similar exercise intensity levels in terms of % of□ VO2 max. The exercise intensities were light (10-20% □ V O2 max), moderate (21-40% □ V O2 max) and high intensities (41-50% □ V O2 max). Heart rate at high work intensity was significantly higher in BE than SN (P<.001). Ventilation and carbon dioxide output were significantly higher in BE than SN at high exercise intensity (P<0.001). Overall, cardiorespiratory stress is less in SN than BE at similar work intensities.

Sinha et al. (2004) to observe critically the energy cost and different cardio respiratory changes during the practice of SN. Twenty-one male volunteers from the Indian Army practiced selected Yogic exercises for six days in a week for three months duration. The Yogic practice schedule consisted of Hatha Yogic Asanas (28 min), Pranayama (10.5 min) and Meditation (5 min). In the Yogic practice schedule 1st they practiced Kapal Bhathi (breathing maneuvers) for 2 min then Yogamudra (yogic postural exercise) for 2 min, after that they took rest until oxygen consumption and heart rate (HR) came to resting value. Subsequently subjects performed SN for 3 min 40 seconds on an average. After three months of training at the beginning of the fourth month subjects performed entire Yogic practice schedule in the laboratory as they practiced during their training session and experiments were carried out. Their pulmonary ventilation, carbon dioxide output, Oxygen consumption, HR and other cardio respiratory parameters were measured during the actual practice of SN. Oxygen consumption was highest in the eighth posture (1.22+/-0.073 1 min(-1)) and lowest in the first posture (0.35+/-0.02 1 min(-1)). Total energy cost throughout the practice of SN was 13.91 kcal and at an average of 3.79 kcal/min. During its practice highest HR was 101+/-13.5 b.p.m. As an aerobic exercise SN seemed to be

ideal as it involves both static stretching and slow dynamic component of exercise with optimal stress on the cardiorespiratory system.

Shenbagavalli and Raj Kumar (2007) investigated the effect of pranayama on selected physiological variables among men volleyball players.Twenty four male subjects for this study were selected from Dr. SivanthiAditanar college of physical education,Tiruchendur randomly and divided into two groups as experimental and control groups. Data were collected from each subject before and after the training. The collected data were statistically analysed by using analysis of covariance(ANCOVA). It was found that there was significant difference on selected physiological variables of resting pulse rate, breath holding time and diastolic blood pressure in the experimental group when compared to the control group.

Hayes M and Chase S. (2010), done a research on "Prescribing Yoga". The study contains the following. More than 15.8 million people in the United States now practice some form of yoga, and nearly half of current practitioners stated they began yoga practice as a means of improving overall health. More broadly understood in a modern context, yoga is a set of principles and practices designed to promote health and well-being through the integration of body, breath, and mind. This article outlines the history of yoga and describes several forms, including asana-based yoga, which is becoming popular in the United States. Research findings related to use of yoga as a therapy for various health problems are reviewed. Guidelines for finding a yoga teacher are offered, as are a number of book and Internet sources of further information.

Tian, Haili·Toriola, Abel L.·Wang, Jian The purpose of the present study was to evaluate the implementation of sunshine sports in secondary schools of Tianjin, China. A total of 450 **physical education** (PE) teachers in 34 secondary schools drawn from six districts in Tianjin participated in the study. A standardized questionnaire was used to obtain information regarding time allocation, extracurricular activities, teacher qualifications and facilities. The results showed that in 64.71% of the secondary schools the time allocation for **physical** activity fell short of the recommended 60 minutes per day for moderate to vigorous physical activity. However, when the number of weekly PE classes was calculated across the schools, the results

showed that 67.65% of the secondary schools in Tianjin met the official requirement for teaching sunshine sports, except during examination period in which 80% of PE classes were substituted by other 'academic' lessons. A total of 75 teachers (60%) were not qualified to teach PE and 62% of the secondary schools had inadequate PE facilities and equipment. It was concluded that most secondary schools in Tianjin did not meet the minimum guidelines on sunshine sports recommended by the Central Committee of the Chinese Communist Party. Deficiencies in physical activity time allocation, insufficient qualified PE teachers and inadequacies in facilities and equipment are considered significant barriers to providing opportunities for developing sunshine sports in the PE curriculum. It is therefore imperative that attention should be given to development of sunshine sports in Tianjin schools. Long-term strategies for developing sunshine sports to enhance high quality PE in prominent secondary schools are recommended.

Krzysztof Stec[1], Rajeev Choudhary[1], Lesław Kulmatycki[2] Purpose. The objective of the study was to determine the ‘effects of dynamic Surya Namaskar (sun salutations) on the differential chest circumference of selected physical education students’ at Banaras Hindu University, Varanasi. Basic procedures. The subjects for this study were selected from the Department of Physical Education at Banaras Hindu University. A total of 20 male subjects were selected and used as one practicing group. Dynamic Surya Namaskar was considered the independent variable and differential chest circumference was considered the dependent variable. The test was for differential chest circumference. The Repeated Measures Design was used for this study. Only one group of 20 participants was created. Tests were administered at regular intervals of two weeks. The tests started four weeks prior to the dynamic Surya Namaskar (DSN) treatment and took place every two weeks, three times. Thereafter, tests took place every two weeks during the treatment and after the completion of the treatment, they were continued for the following four-week period. Main findings. To determine the effect of dynamic Surya Namaskar on physiological and anthropometric variables of selected physical education students at Banaras Hindu University, Varanasi, one way ANOVA was used at .05 level of significance. Conclusions. In relation to differential chest circumference, a significant ($p < 0.05$) effect of dynamic Surya Namaskar was found.

CHAPTER-III

METHODOLOGY

Subjects

Thirty (30) male cricket player who plays cricket in regular basis from West Bengal will be selected as subjects for the study. The age of the subject will be ranged from 18-25. The subjects will categorized into two groups i.e. dynamic stretching warm up and fast surya namskar.

Criterion Measures

The test items selected for this study were standardized and appropriate for the motor performance on selected parameters. The criterion measures are presented in the **table-1.**

TABLE-1

TESTS SELECTION

Sl. No	Criterion Variables	Test Items	Criterion Measures
1	**20mts. Sprint**	20mts. Run	Sec.
2	**Muscular Strength Endurance**	Sit up and push up	Numbers
3	**Agility**	T test	Sec.
4	**Power**	Countermovement jump	Centimeter
5	**Ball Speed**	Radar Gun	Km/hour
6	**Ball Accuracy**	The accuracy target Test	numbers

Research Design

The experimental design will be used in this study is pretest-posttest design.

Experimental Protocol

Prior to the beginning of the experimental protocol subjects standing heights and weights will be measured by using stadiometer, weighing machine and history of injury information will be taken from the bowlers.

For the purpose of the experimental protocol after completing normal warm up procedures the bowlers of the two groups will be given a protocol of dynamic stretching of 10 mins and fast suryanamaskar practice for 10 mins.

The selected neuromuscular variables namely speed, Muscular Strength Endurance, Muscular Strength, Agility, Flexibility, Power and bowling performance namely Ball Speed, Ball Accuracy will be measured prior and after the experimental protocol.

Training schedule

Group I (The Dynamic Warm-up (DW) group)

The warm-up protocols concentrated on the quadriceps, hamstrings, gastrocnemius, soleus, gluteal, adductors and hip flexors. The Dynamic Warm-up (DW) protocol to be used will be a series of specific progressive exercises lasting a total of 10 minutes over a distance of 20m with a jog recovery (Young, 2007)

Dynamic Stretching Protocol (DW)

Dynamic Flexibility Protocol	Distance & Reps
Ankle Flicks - Gentle skips plantar flexing the ankles	**20m x 1**
Jogging Skips - Rising to the toes, maintaining good posture with use of arms to counterbalance.	**20m x 1**
High Knees - Forwards running with exaggerated knee lift driving of the arms, fast legs slow travel	**20m x 1**
Heel Flicks - forwards running with exaggerated knee flexion driving the arms, fast legs slow travel.	**20m x 1**
Small 2 footed Jumps - feet shoulder width apart, flexing at knees then extending jumping off the ground and repeating	**20m x 1**
Lateral running - step laterally driving the arms and legs, ensure feet do not cross (Repeat leading with opposite foot)	**20m x 2**
Squats - step laterally to feet shoulder width apart and then gradually squat while keeping the trunk stable, extend forcefully into standing and repeat. Repeat leading with the opposite foot	**20m x 2**
Carioca - sideways running, trail leg to move past the lead leg, once behind then in front, with exaggerated hip rotation (Repeat leading with the opposite foot)	**20m x 2**
High Knee Skip - as with jogging skips, but now extend on to the toes forcefully and leave the ground, driving with the arms and raising opposite knee (emphasis on vertical height)	**20m x 1**
Zig Zags - Knees flexed 2 steps to the left followed by 2 steps to the right repeated over 20m	**20m x 1**
Russian Walk – flexing at the hip then extending at the knee till the leg is fully extended parallel to the floor, pull the leg from an extended position back to the floor with toes pointing upwards	**20m x 1**
Two High Jumps, one small - flexing the knees perform two vertical jumps advancing forward followed by one small vertical jump, using the arms –repeated over 20m	**20m x 1**
Open, close gate - abduct the thigh laterally from the hip and rotate the thigh forwards, followed by same action on the opposite leg repeated over 20m –repeat moving backwards lifting and flexing the knee and rotating at the hip to an abducted position followed by same action on opposite leg	**20m x 2**
Lunges - step through with one foot, flexing at the knees and lowering the body towards the floor keep good posture, extend to a standing position and step through with opposite and repeat	**20m x 1**
Sprints 70, 80 & 90% of Max Speed – 20 metre sprints at increased intensity levels of perceived maximum speed	**20m x 3**

Group II (Fast Suryanamaskar group)

Subjects will be trained to perform suryanamaskar by a qualified instructor. Surya Namaskar consists of a sequence of 12 postures performed in a rhythmic manner starting in an upright standing position and then moving into alternate forward and backward bending movements interspaced with movements involving all four limbs before ending the practice in an erect standing position. (Giri Swami Gitananda,1981; Yogeswar, 1980)

The subjects will be trained to perform suryanamaskar in a rapid manner so that all 12 postures were completed in 2 minutes 6 rounds will be performed in 10-12 minutes.

Twelve Sun salutations.

Step 1: Hasta uttanasan (raised arms pose)
Step 2: Padhahastasan (standing forward bend pose)
Step 3: Ekapadaprasaranasana (equestrian pose)
Step 4: Dwipadaprasaranasana (steep parellel pose)
Step 5: Sasankasana (moon pose)
Step 6: Sashtanga Namaskar (Salute with 8 limbs pose)
Step 7: Bhujangasan (cobra pose)
Step 8: Parvatasan (mountain pose)
Step 9: Sasankasana (moon pose)
Step 10: Ekapadaprasaranasana (equestrian pose)
Step 11: Padhastasan (standing forward bend pose)
Step 12: Hasta uttanasan (raised arms pose)

Instrument and tools to be used

The instrument and tools to be used for this study are presented in the **table-2.**

TABLE-2

INSTRUMENT AND TOOLS USED

Sl. No	Criterion Variables	Instruments
1	**20mts. Sprint**	Stop Watch
2	**Muscular Strength Endurance**	Stop Watch & mat
3	**Agility**	Stop Watch, Marking tape, Marker
4	**Power**	Measuring tape, chalk dust
5	**Ball Speed**	Radar Gun
6	**Ball Accuracy**	Ball, Stump, marking tape, cloth

Administration of Tests

1. 20mts. Sprint

This test requires the cricketers to maximally sprint for 20 meters

- The cricketers will be completed an adequate warm up of around 10 minutes duration
- The cricket players will be lines up at the start mark (0m)
- Cricketers will be starts when ready or on "GO" command from a coach/ researcher.
- The players will be sprints from 0 meters to 20 meters between the cones.
- The time will be recorded when the players crosses the finish line at 20 metres
- The test will be completed 2 times with a 5 minute break between runs.

2. Muscular Strength Endurance

Push-Up

Test Objective

To complete as many 90° push-ups as possible at a rhythmic pace. This test item is used for male cricket players.

Test Instructions

The students should be paired; one will perform the test while the other counts 90° push-ups and watches to see that the student being tested bends the elbow to 90° with the upper arm parallel to the floor. The student being tested assumes a prone position on the mat with hands placed under or slightly wider than the shoulders, fingers stretched out, legs straight and slightly apart, and toes tucked under. The student pushes up off the mat with the arms until arms are straight, keeping the legs and back straight. The back should be kept in a straight line from head to toes throughout the test. The student then lowers the body using the arms until the elbows bend at a 90° angle and the upper arms are parallel to the floor. This movement is repeated as many times as possible. The student should push up and continue the movement until the arms are straight on each repetition. The rhythm should be approximately 20 90° push-ups per minute or 1 90° push-up every 3 seconds.

Scoring

The score is the number of 90° push-ups performed. For ease in administration, it is permissible to count the first incorrect 90° push-up. It is important to be consistent with all of the students and classes when determining if you will count the first incorrect push-up.

3. Agility

Agility T-Test

- **procedure:** Set out four cones as illustrated in the diagram above (5 yards = 4.57 m, 10 yards = 9.14 m). The subject starts at cone A. On the command of the timer, the subject sprints to cone B and touches the base of the cone with their right hand. They then turn left and shuffle sideways to cone C, and also touches its base, this time with their left hand. Then shuffling sideways to the right to cone D and touching the base with the right hand. They then shuffle back to cone B touching with the left hand, and run backwards to cone A. The stopwatch is stopped as they pass cone A.

- **scoring:** The trial will not be counted if the subject cross one foot in front of the other while shuffling, fails to touch the base of the cones, or fails to face forward throughout the test. Take the best time of three successful trials to the nearest 0.1 seconds. The table below shows some scores for adult team sport athletes.

4. Power

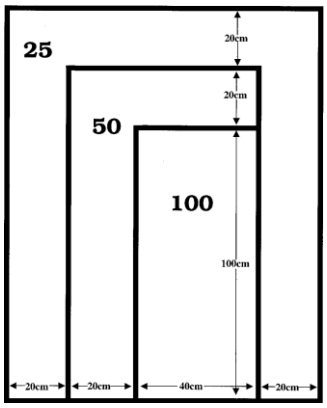
A countermovement jump (CMJ) test will be used as a measure of lower limb explosive power production. To complete this task, subjects stood 15 cm away from and perpendicular to the wall (Markovic, G, 2004). Ink was placed on the tip of their middle finger. Subjects were allowed to step back with either foot while keeping the other foot in place. From this one-step preparatory position, the subjects were asked to step forward with the back leg and jump off of both feet. The subjects were instructed to make a mark on the wall at the highest point of their jump using their inked finger. Subjects completed three jumps in succession. The CMJ score was calculated by subtracting the standing reach height (m1) obtained during the familiarization session, from the highest jump height (m2) obtained. Test retest reliability was 0.980 for the countermovement jump test by Unick (Unick, J, 2005).

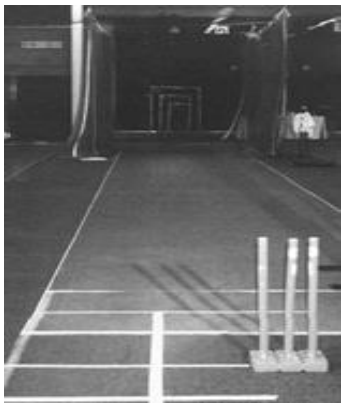
5. Ball Speed:

To assess ball release speed, a radar gun (M10P) will be placed two-thirds down the pitch towards the batting crease, in a stand adjacent to the pitch and aimed at the point of ball release for each bowler. Ball release speed was measured for each delivery of the over to ensure bowlers were maintaining their efforts throughout the over.

6. Ball Accuracy

The target will be painted in white on a black cotton sheet and suspended from overhead 30 cm in front of the batter' s stumps. It has three scoring zones (100, 50,25), with its design rewarding those balls passing a line of middle stump to approximately 25 cm outside of stump, and from a good length or just short of a good length, with a maximum score of 100 points. The other two zones rewarded deliveries with either 50 or 25 points depending on their impact point on the target. Those deliveries that did not hit the target or the black sheet (the sheet will be larger than the target) received a score of zero. The base of the target will be 50 cm above the ground (stumps 71 cm high) so that deliveries of too full a length would pass under the target and receive a score of zero. Deliveries of too short a length would also hit the target in a low or zero scoring zone. Figure 4 shows the accuracy target set-up. A second floor target area 30 cm wide (width measured from leg stump towards off -side) and 100 cm long will be marked on the pitch from the base of the batting stumps towards the bowler. Bowlers were requested to bowl three `yorkers' during their spell and to nominate the yorker delivery before its attempt. These deliveries will be awarded 100 points if the ball first pitched within the target area. If a nominated yorker delivery did not pitch in the target area, a score of zero will be awarded to simulate the high risk of this delivery in matches. A nominated yorker ball that hit the regular zoned target sheet also received a score of zero. If a delivery impacted the target on a painted line between two zones, the higher score (inner zone) will be awarded. All deliveries during the over received an accuracy score.





Dimensions and scoring zones of the accuracy target to be used during the bowling.

Procedure of Collection of Data

Prior to the beginning of the experimental protocol subjects standing heights and weights will be measured by using stadiometer, weighing machine and history of injury information will be taken from the bowlers.

For the purpose of the experimental protocol after completing normal warm up procedures the bowlers of the two groups will be given.

The selected neuromuscular variables namely speed, Muscular Strength Endurance, Agility, Power and bowling performance namely Ball Speed, Ball Accuracy will be measured prior to the warm-up protocols and after the protocol of dynamic stretching of 10 mins and fast suryanamaskar practice for 10 mins post test data will be collected.

Analytical Procedure to be used

The basic statistical parameters will be calculated for all the data: the mean and standard deviation.

Student's (paired) *t* test to compare pre- and post-training values of each group. Student's (unpaired) *t* test will be used to compare the values between the groups before and after training. A P value of less than 0.05 will be accepted as indicating significant difference between the compared values.

KEYWORDS:

STRETCHING, DYNAMIC SURYANAMASKAR, BOWLING PERFORMANCE, CRICKET

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